

I-77 Feasibility Study (I-85 to Griffith Street)

TIP Project No. FS-0810B

**Task Order No. 2 – I-77 HOV/HOT Conversion
Sub-task 2.C.2: Evaluation of Operational Impacts**

TECHNICAL MEMORANDUM

(FINAL)

November 18, 2009

1.0 INTRODUCTION

This memorandum summarizes the results of traffic simulation conducted along I-77 for the proposed conversion of the existing high-occupancy vehicle (HOV) facility to high-occupancy toll (HOT) lanes and the possible extension of the HOT lanes to Griffith Street in Davidson (Exit 30). The corridor's existing HOV facility extends from about Hambright Road to Oaklawn Avenue in the southbound direction and from Cindy Lane to I-485 in the northbound direction.

The traffic simulation and analysis package used in Task Order No. 2, CORSIM, was developed for the Federal Highway Administration (FHWA). CORSIM has the capability to analyze traffic flows on surface street systems as well as freeways, and can consider the effects of additional lanes, on-street parking, bus traffic, and accidents.

There were three HOT lanes options analyzed as part of this task order:

- Option 1 - convert the existing HOV lanes to HOT lane operations.
- Option 2 - convert the existing HOV facility to HOT lanes plus extend only the HOT lane from the current HOV facility terminus located south of I-485 (Exit 19) to Griffith Street
- Option 3 - convert the existing HOV facility to HOT lanes plus add a HOT lane and a general purpose lane in each direction between the current HOV facility terminus near Exit 19 and Exit 30 as discussed above for Option 2.

For Task Order No. 2, CORSIM was used to:

- Assess the impact of HOV-to-HOT lanes conversion of the existing facility and the extension of HOT lanes through Griffith Street (Exit 30) on freeway operations
- Assess the system impacts on a comprehensive scale
- Determine freeway residual impacts, if any, resulting from the proposed freeway modifications

1.1 CORSIM MODEL CALIBRATION

The default values of the CORSIM model have not been changed. The calibration for the existing No-Build conditions was not necessary as the speeds, volumes and observed queuing were reasonably close (within 10 percent) to observed existing conditions.

The CORSIM output file was created from the average of three internal CORSIM runs. The output results are the average of three random runs.

1.2 CORSIM NETWORK AND TRAFFIC ANALYSIS

The CORSIM network for Task Order No. 2 was prepared from the base existing conditions network. Using the existing network, the current HOV facility was converted to HOT lanes to create Option 1. Under Option 2, the converted HOT lane was extended to Griffith Street (Exit 30). In Option 3, a HOT lane plus another general purpose lane was added through Griffith Street (Exit 30) in the northbound and southbound directions. The volumes for the three options were estimated using results from the Metrolina Regional Travel Demand Model. Traffic analysis was performed for the planning years of 2013 and 2030 for AM and PM peak hour conditions.

2.0 RESULTS OF TRAFFIC SIMULATION

The following sections summarize the results of CORSIM traffic analysis for the three options.

2.1 CONVERSION OF EXISTING HOV FACILITY TO HOT LANES

2.1.1 2013 AM Peak Hour (Southbound)

Based on a comparison to no-build conditions, the level of service along I-77 would improve slightly following the HOV-to-HOT lanes conversion. Average speeds along I-77 would increase from 42 miles per hour (mph) to 44 mph while overall delay for vehicles traveling along the freeway would decrease from 47 minutes to 43 minutes, a 9 percent improvement.

2.1.2 2013 PM Peak Hour (Northbound)

The level of service along I-77 would once again improve slightly following the HOV-to-HOT lanes conversion. Average speeds along I-77 would increase from 44 mph to 46 mph while overall delay for vehicles traveling along the freeway would decrease from 51 minutes to 47 minutes, an 8 percent improvement.

2.1.3 2030 AM Peak Hour (Southbound)

Based on a comparison to no-build conditions, the level of service along I-77 would improve slightly following the HOV-to-HOT lanes conversion. Average speeds along I-77 would increase from 35 mph to 39 mph while overall delay for vehicles traveling along the freeway will decrease from 80 minutes to 67 minutes, a 16 percent improvement.

2.1.4 2030 PM Peak Hour (Northbound)

The level of service along I-77 would once again improve slightly following the HOV-to-HOT lanes conversion. Average speed along I-77 would increase from 44 mph to 46 mph while overall delay for vehicles traveling along the freeway would decrease from 58 minutes to 53 minutes, a 9 percent improvement.

2.2 HOV/HOT CONVERSION AND HOT LANE EXTENSION

2.2.1 2013 AM Peak Hour (Southbound)

When compared to No-Build conditions, the level of service will improve by two grades for southbound operations along I-77 between LaSalle Street and Griffith Street. The level of service would improve from a level of service "F" to a level of service "D" for not only on and off ramp locations but also mainline southbound freeway operations.

The average speed along I-77 would improve by 9 mph, from 42 mph to 51 mph. Overall vehicular delay time will decrease from 47 minutes to 31 minutes, a reduction of over 16 minutes (34 percent improvement) for vehicles traveling along I-77.

2.2.2 2013 PM Peak Hour (Northbound)

The level of service for I-77 northbound operations will also improve by two levels when compared to No-Build conditions. Once again, the level of service would improve from a level of service “F” to a level of service “D” for not only ramp locations but also mainline northbound freeway operations.

Average travel speeds would improve by 9 mph, from 44 mph to 53 mph. Overall vehicular delay time will decrease from 51 minutes to 31 minutes, a drop of 20 minutes (39 percent reduction) for vehicles using I-77.

2.2.3 2030 AM Peak Hour (Southbound)

When compared to No-Build conditions, the level of service will improve by a two levels for southbound operations along I-77 between LaSalle Street and Griffith Street. The level of service improves from a level of service “F” to a level of service “D” not only at ramp locations but also for mainline southbound freeway operations.

Overall I-77 speeds would increase by 16 mph, from 35 mph to 51 mph. Overall vehicular delay time will decrease from 80 minutes to 34 minutes, a reduction of 46 minutes (58 percent reduction) for I-77 motorists.

2.2.4 2030 PM Peak Hour (Northbound)

The level of service for I-77 northbound operations will again improve by two levels when compared to No-Build conditions. Similar to the CORSIM results for 2013 operations, the level of service improves from a level of service “F” to a level of service “D” not only at on and off ramp locations but also for mainline northbound freeway operations.

Average speeds along I-77 would improve by 5 mph, from 44 mph to 49 mph. Overall vehicular delay time will decrease from 58 minutes to 42 minutes, about 16 minutes less representing a 28 percent reduction for I-77 travelers.

2.2.5 Northbound Lane Termini

Based on CORSIM analysis results, designation of the proposed HOT lane would end about ½-mile south of Exit 28. Traffic in the northbound general purpose lanes would merge to the leftmost lane ensuring that HOT lanes users have priority when three northbound lanes are reduced to two lanes. The outside general purpose lane would drop at the exit ramp at Catawba Avenue (Exit 28).

The southbound HOT lane would begin south of the causeway between Exits 28 and 30.

2.3 HOV/HOT LANES CONVERSION PLUS EXTENSION OF HOT LANES AND GENERAL PURPOSE LANES

2.3.1 2013 AM Peak Hour (Southbound)

When compared to No-Build conditions, the level of service is projected to improve by three levels for southbound operations along I-77. The level of service would improve from a level of service "F" to a level of service "C" at on and off ramp locations and for mainline southbound freeway operations.

The average speed along I-77 will improve by 7 mph, from 42 mph to 49 mph. Overall vehicular delay time would decrease from 47 minutes to 35 minutes, a reduction of 12 minutes, representing a 25 percent improvement, for all vehicles traveling along I-77.

2.3.2 2013 PM Peak Hour (Northbound)

The level of service for northbound operations would improve by three levels along the I-77 section between LaSalle and Griffith Streets when compared to No-Build conditions. The level of service improves from a level of service "F" to a level of service "C" not only at ramp locations but also for mainline northbound freeway operations.

Average I-77 speeds are forecasted to improve by 14 mph, from 44 mph to 58 mph. Overall vehicular delay time decreased from 51 minutes to 20 minutes, a drop of over 31 minutes (61 percent reduction) for vehicles using I-77.

2.3.3 2030 AM Peak Hour (Southbound)

When compared to No-Build conditions, the level of service is projected to improve by two grades for I-77 southbound operations. The level of service improves from a level of service "F" to a level of service "C" for both ramp locations and for mainline operations.

The average speed along I-77 would improve by 25 mph, from 35 mph to 60 mph. Overall vehicular delay time is shown to decrease from 80 minutes to 20 minutes, a one-hour reduction of 60 minutes for I-77 motorists.

2.3.4 2030 PM Peak Hour (Northbound)

The level of service for I-77 northbound operations would improve by three levels when compared to No-Build conditions. The level of service is projected to improve from a level of service "F" to a level of service "C" at ramp locations and for mainline operations.

The overall travel speed will improve by 7 mph, from 44 mph to 51 mph. Overall vehicular delay time will decrease from 58 minutes to 36 minutes, 22 minutes less representing a 38 percent reduction for I-77 travelers.

2.3.5 Northbound Lane Termini

The CORSIM analysis for adding two lanes (one HOT lane and one general purpose lane) in each direction to I-77 indicated a need to widen the I-77 causeway between Griffith Street (Exit 30) and Langtree Road (Exit 31) in order to prevent a bottleneck from merging traffic in the afternoon peak period where the northbound HOT lane ends. HOT lane designation would end just north of Exit 30 but the new lane would continue north as a general purpose lane. One general purpose lane would drop at the off ramp at Exit 28, resulting in I-77 having three northbound lanes to Langtree Road (Exit 31) where another general purpose lane would end at this recently-completed interchange.

2.4 TRAFFIC OPERATIONS ANALYSIS LANE DIAGRAMS

- The appendix, *I-77 CORSIM Traffic Simulation Results, Task Order No. 2 Alternatives*, includes a series of lane diagrams that depict the results of the CORSIM simulation analyses along the corridor. The lane diagrams show forecasted peak hour volumes, projected density and speed for mainline sections and modeled peak hour volumes for entrance and exit ramps. It also shows the expected operational levels of services for the various segments along the corridor.

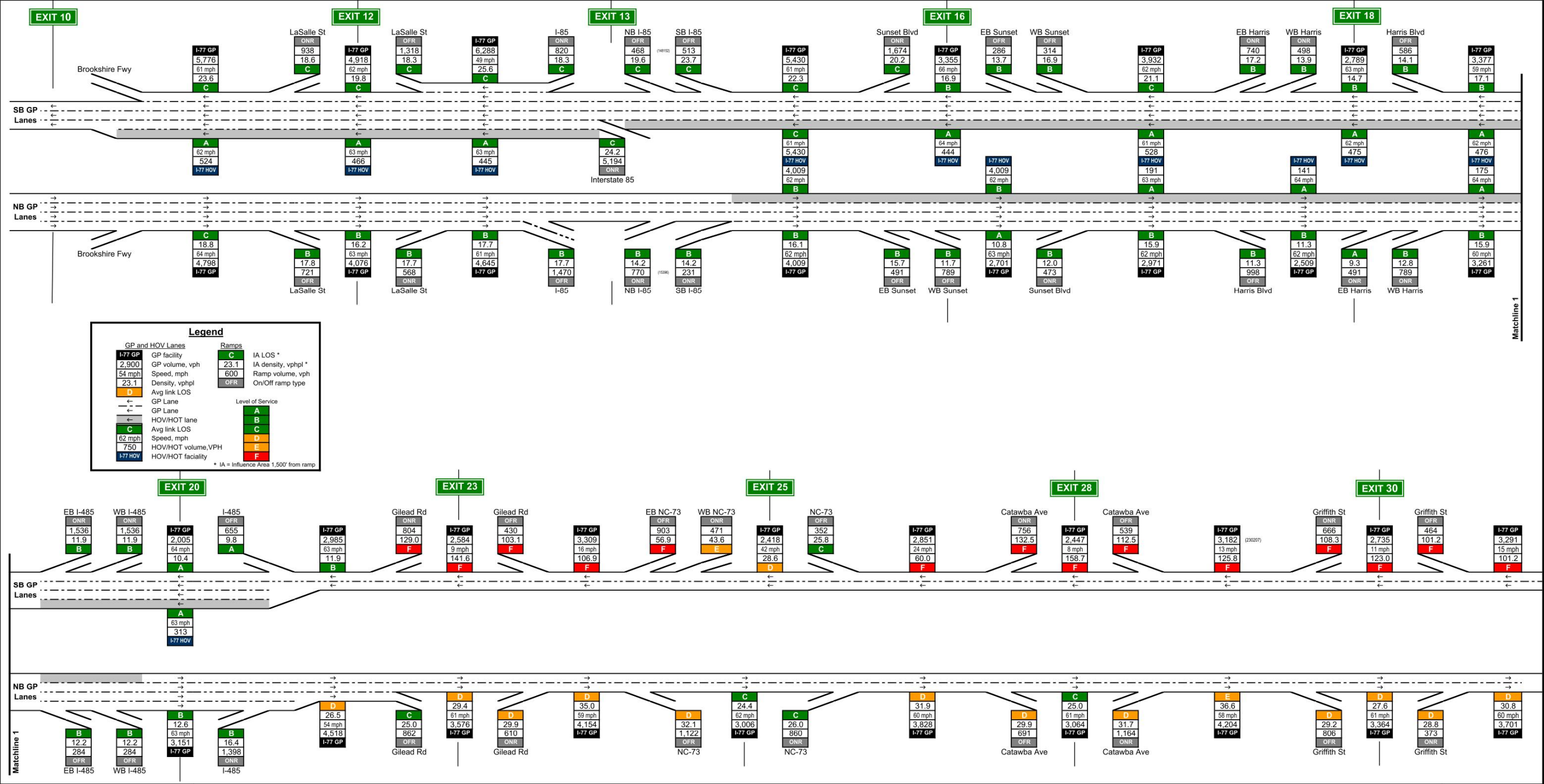
APPENDIX

I-77 CORSIM Traffic Simulation Results

Task Order No. 2 – HOV/HOT Conversion

Alternatives

Figures	Year	Peak	Cross-section
Figure A-1	2013	AM	NoBuild
Figure A-2	2013	PM	NoBuild
Figure A-3	2030	AM	NoBuild
Figure A-4	2030	PM	NoBuild
Figure A-5	2013	AM	Convert existing HOV to HOT
Figure A-6	2013	PM	Convert existing HOV to HOT
Figure A-7	2030	AM	Convert existing HOV to HOT
Figure A-8	2030	PM	Convert existing HOV to HOT
Figure A-9	2013	AM	3 Lanes (1 HOT & 2 GP) (missing)
Figure A-10	2013	PM	3 Lanes (1 HOT & 2 GP)
Figure A-11	2030	AM	3 Lanes (1 HOT & 2 GP)
Figure A-12	2030	PM	3 Lanes (1 HOT & 2 GP)
Figure A-13	2013	AM	4 Lanes (1 HOT & 3 GP)
Figure A-14	2013	PM	4 Lanes (1 HOT & 3 GP) (missing)
Figure A-15	2030	AM	4 Lanes (1 HOT & 3 GP)
Figure A-16	2030	PM	4 Lanes (1 HOT & 3 GP)



I-77 HOV Study: CORISIM Model Volume Density and Speed Results

2013 AM No-Build

Figure A-1

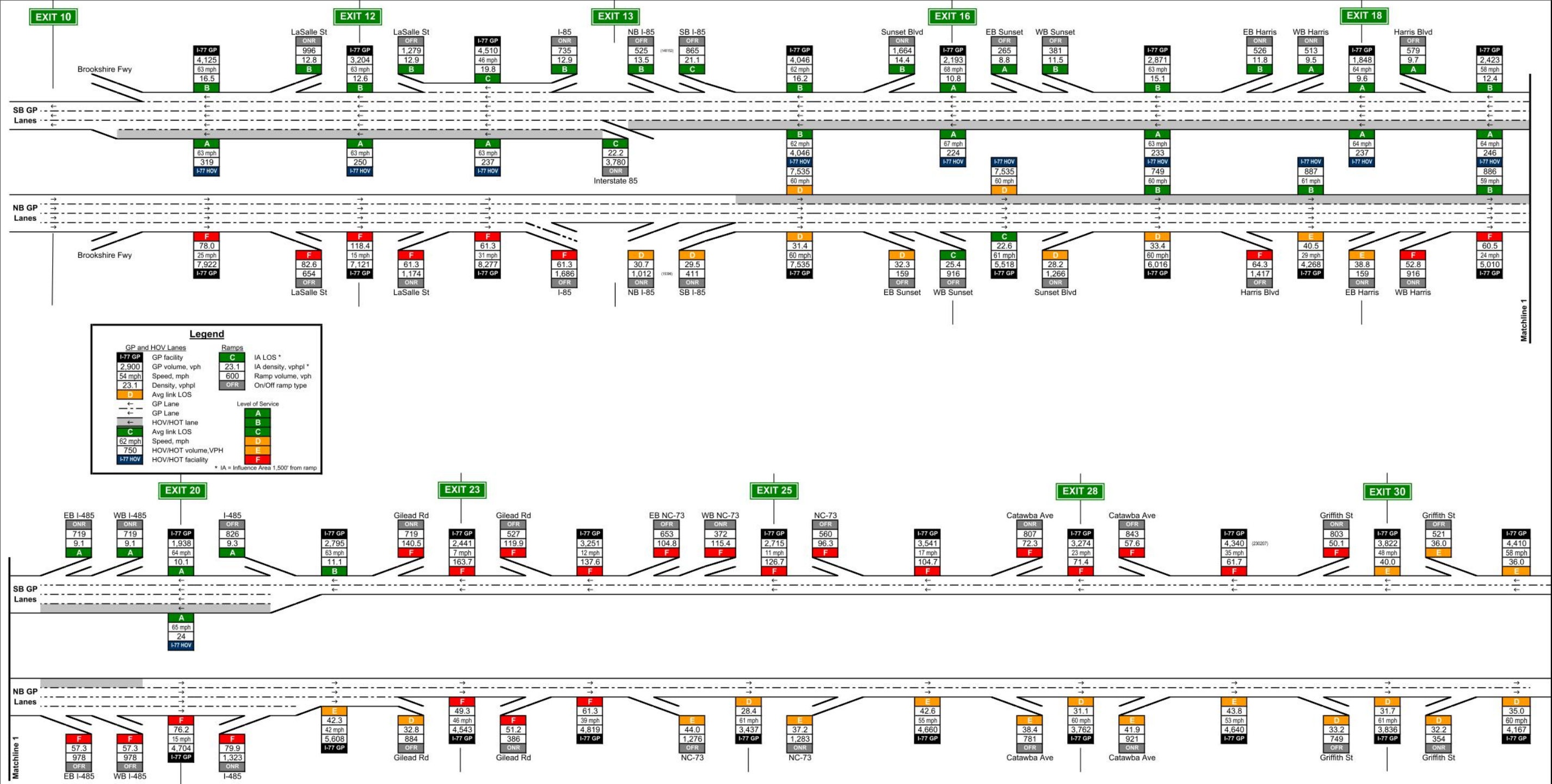
Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)

AM Peak Period (7:00 a.m. to 8:00 a.m.)

Date: October 20, 2009

Created by: Dhiraj Goverdhanam

Approved by: Jonathan Reid



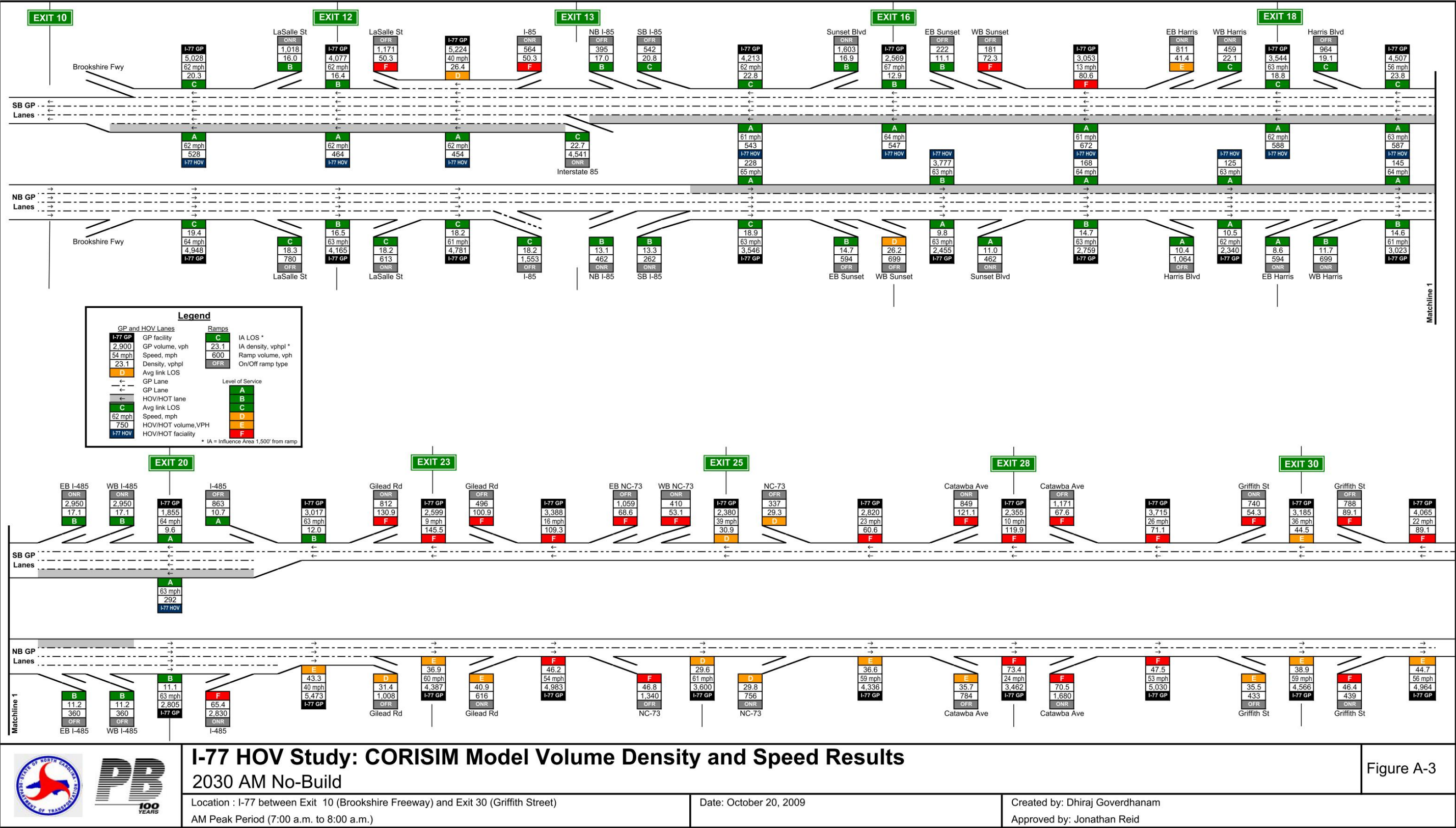
I-77 HOV Study: CORISIM Model Volume Density and Speed Results 2013 PM No-Build

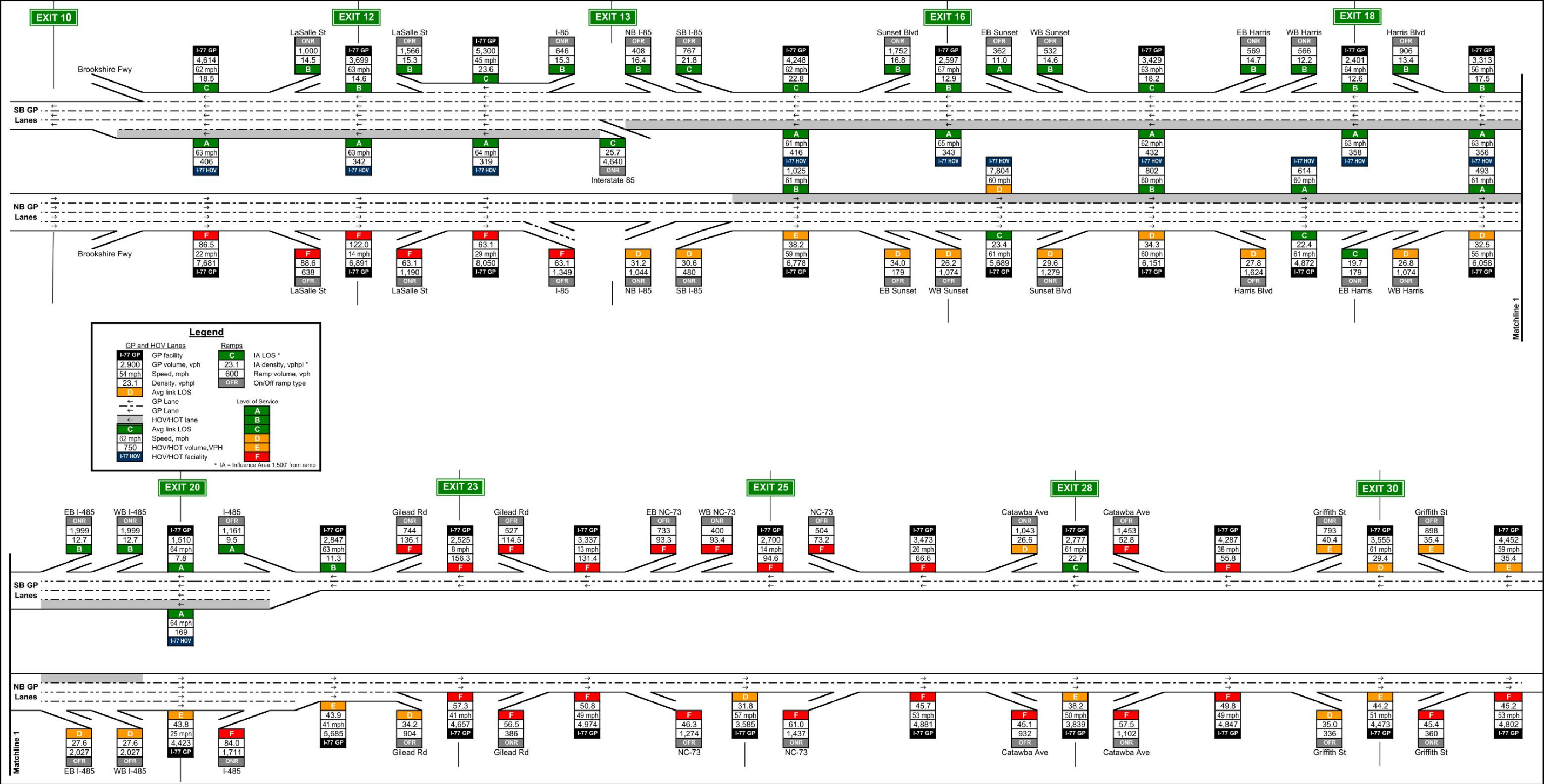
Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
PM Peak Period (5:00 p.m. to 6:00 p.m.)

Date: October 20, 2009

Created by: Dhiraj Goverdhanam
Approved by: Jonathan Reid

Figure A-2





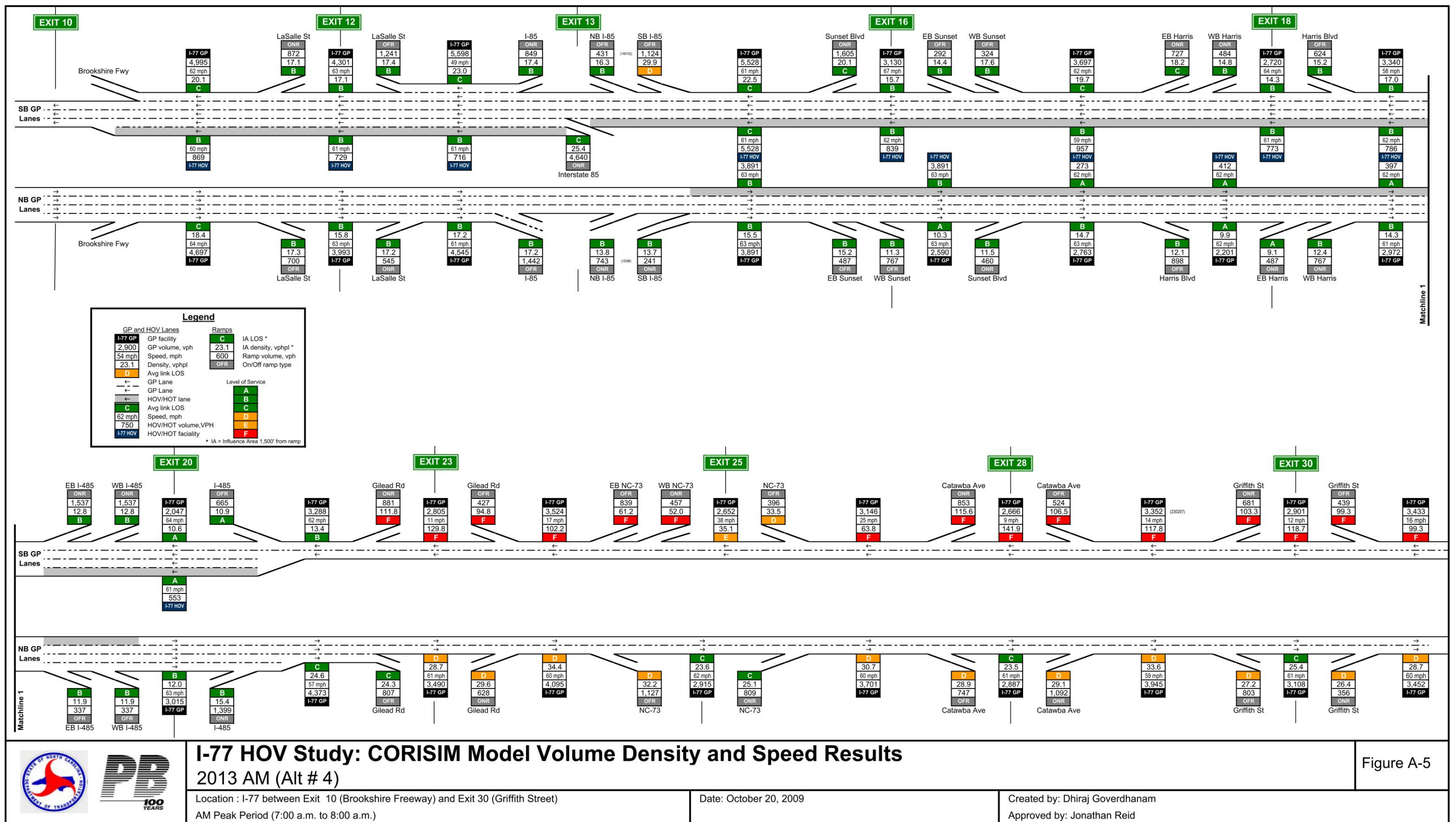
I-77 HOV Study: CORISIM Model Volume Density and Speed Results

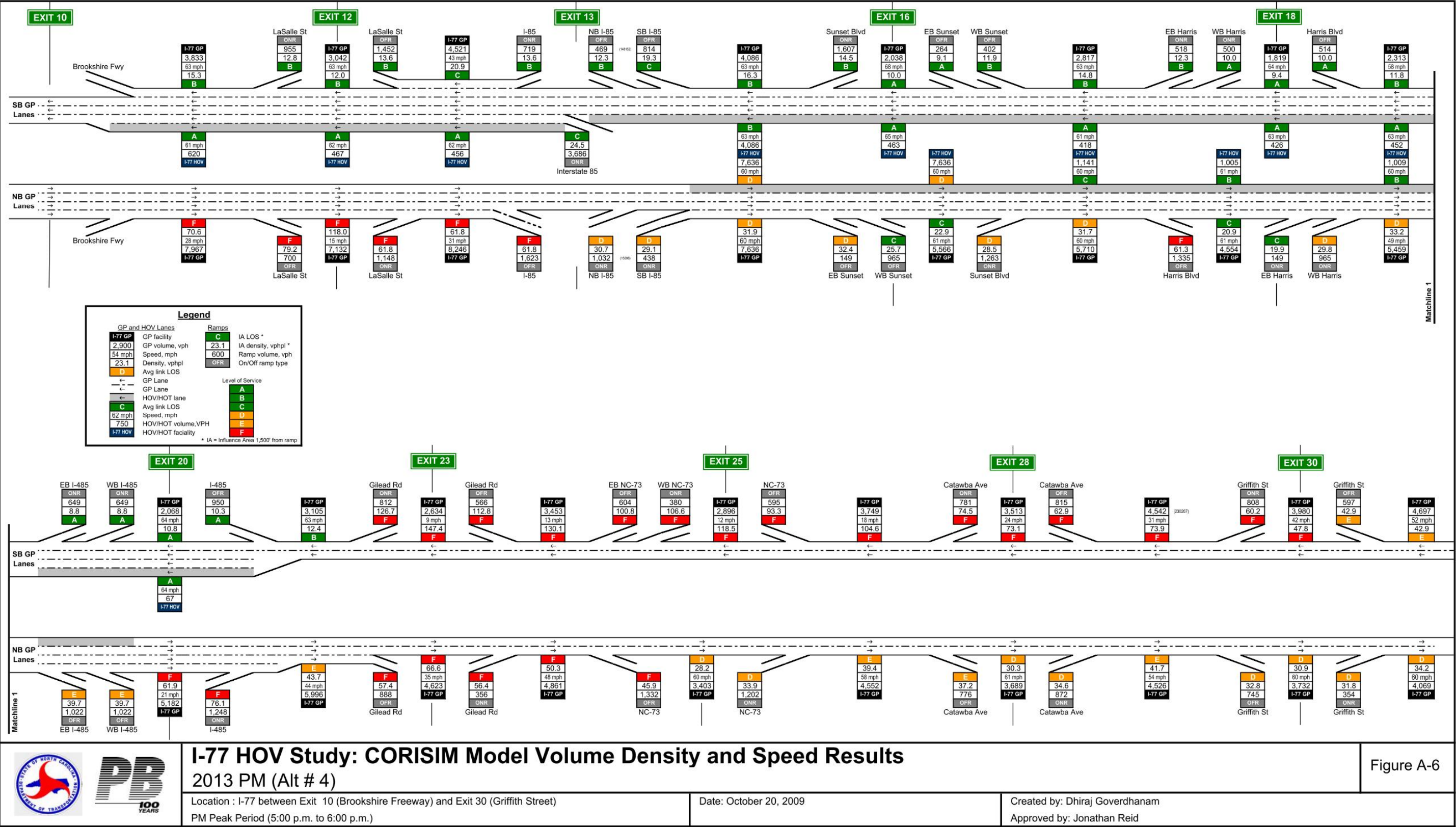
2030 PM No-Build
 Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
 PM Peak Period (5:00 p.m. to 6:00 p.m.)

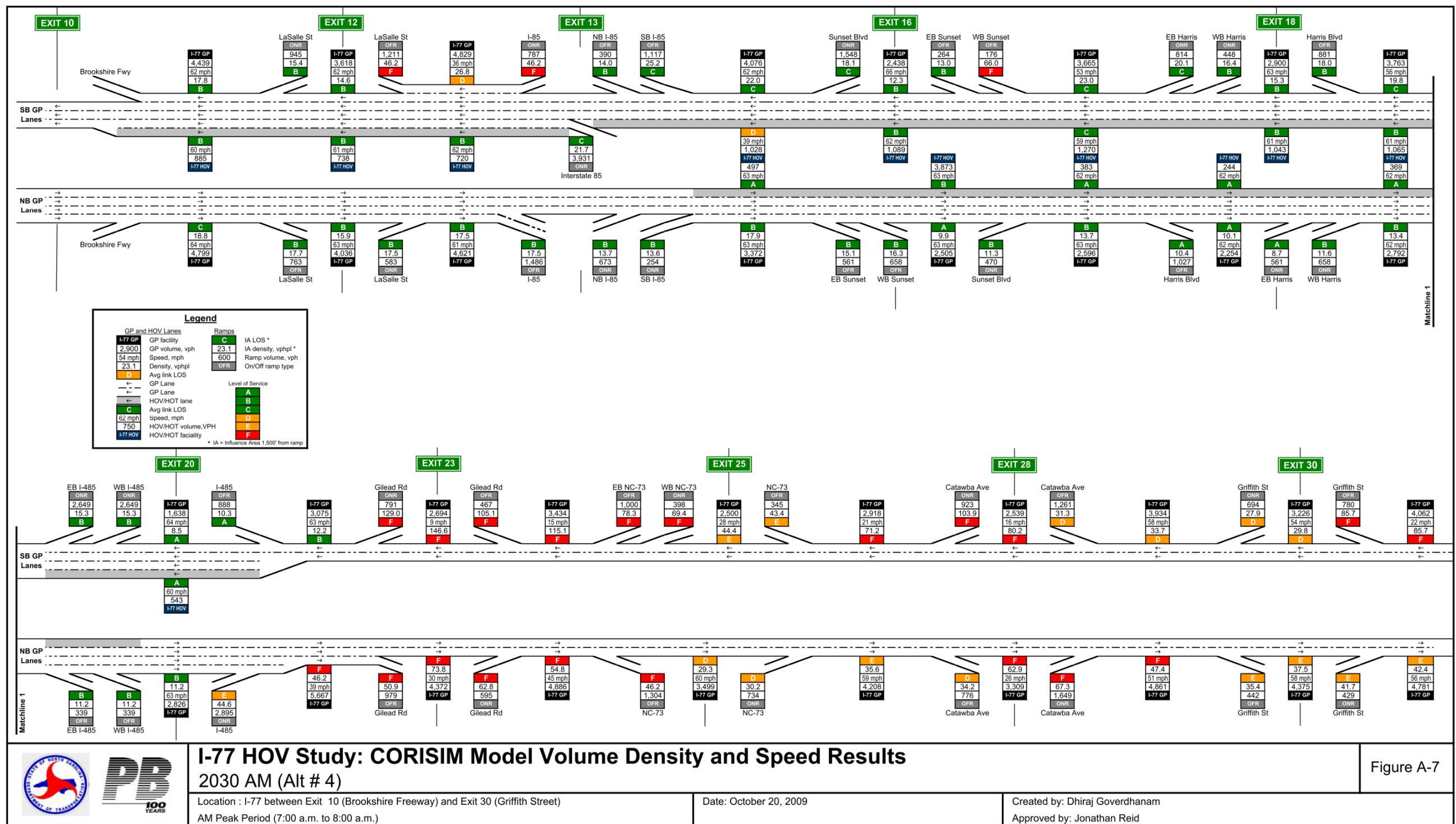
Date: October 20, 2009

Created by: Dhiraj Goverdhanam
 Approved by: Jonathan Reid

Figure A-4







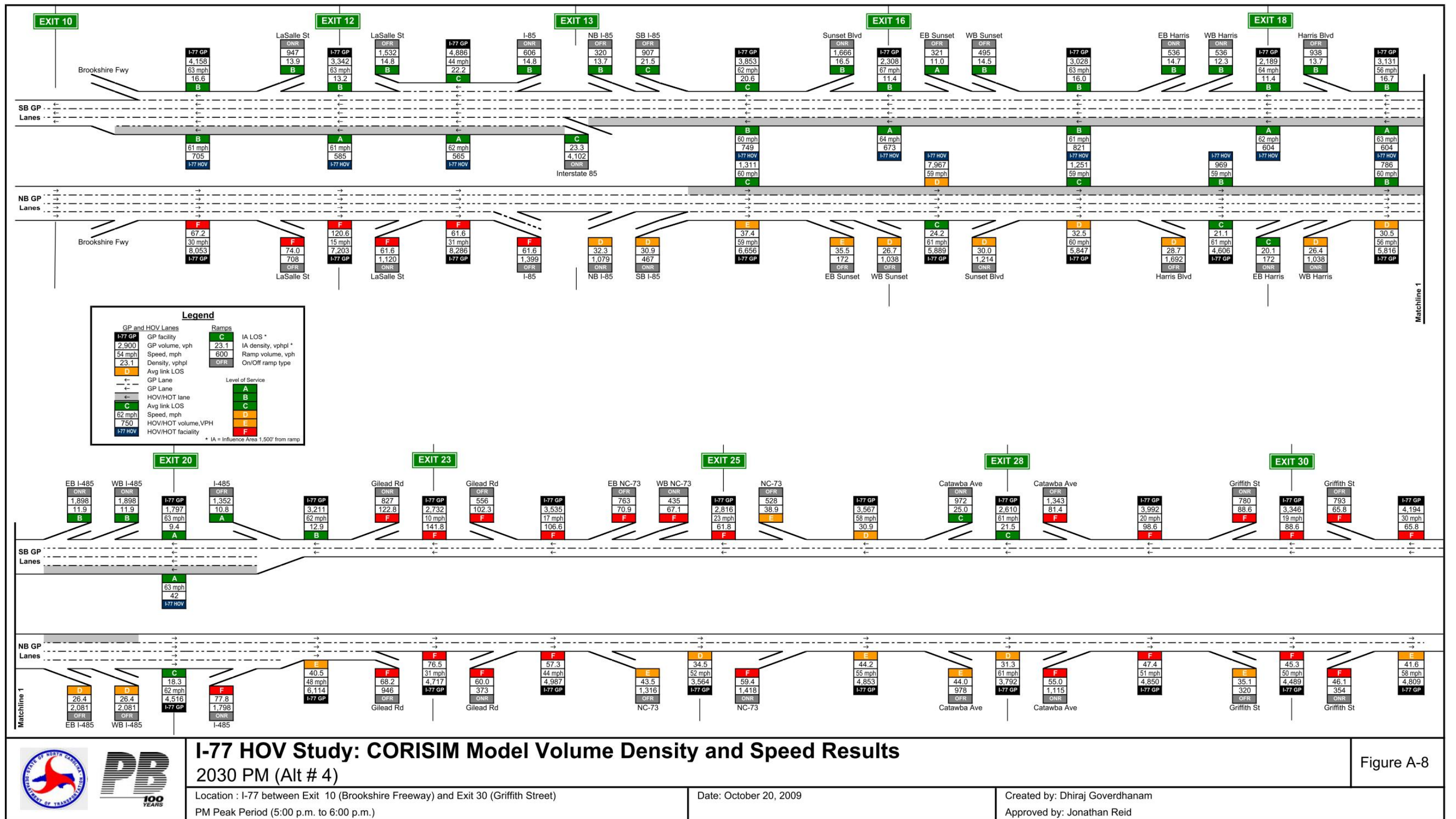
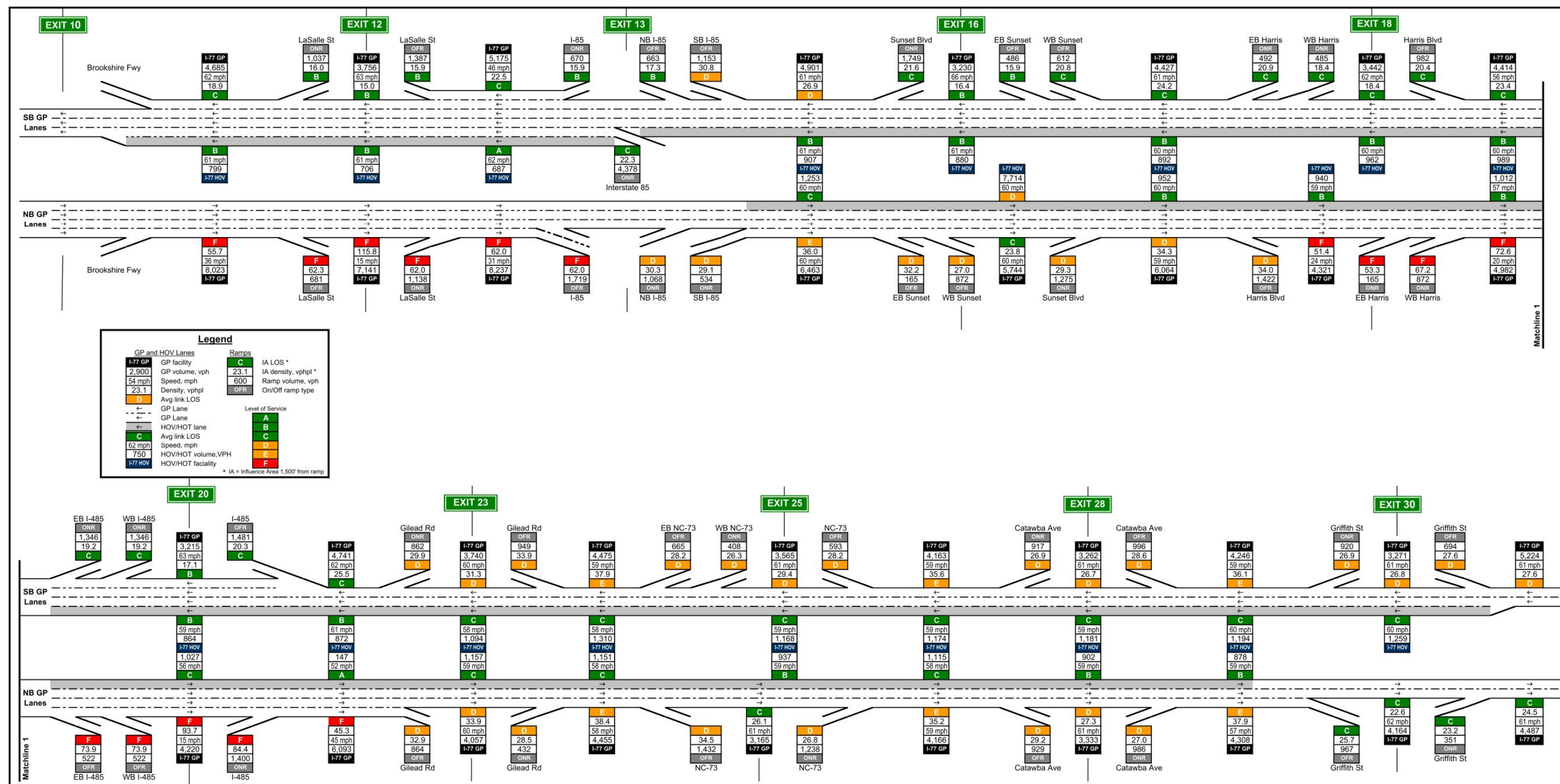


Fig 9 is missing



I-77 HOV Study: CORISIM Model Volume Density and Speed Results

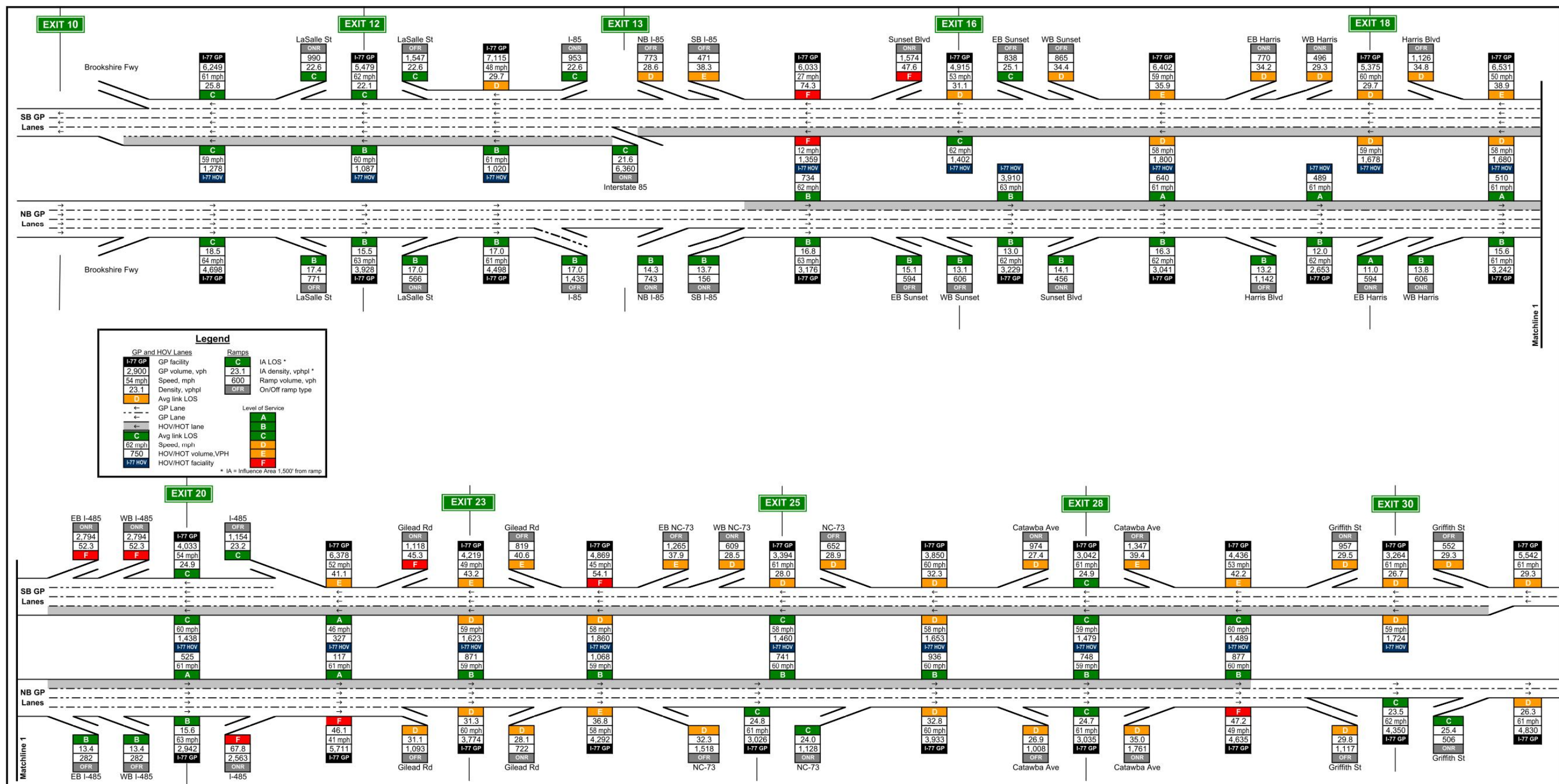
2013 PM (Alt # 5)

Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
PM Peak Period (5:00 p.m. to 6:00 p.m.)

Date: October 21, 2009

Created by: Dhiraj Goverdhanam
Approved by: Jonathan Reid

Figure A-10



I-77 HOV Study: CORISIM Model Volume Density and Speed Results

2030 AM (Alt # 5)

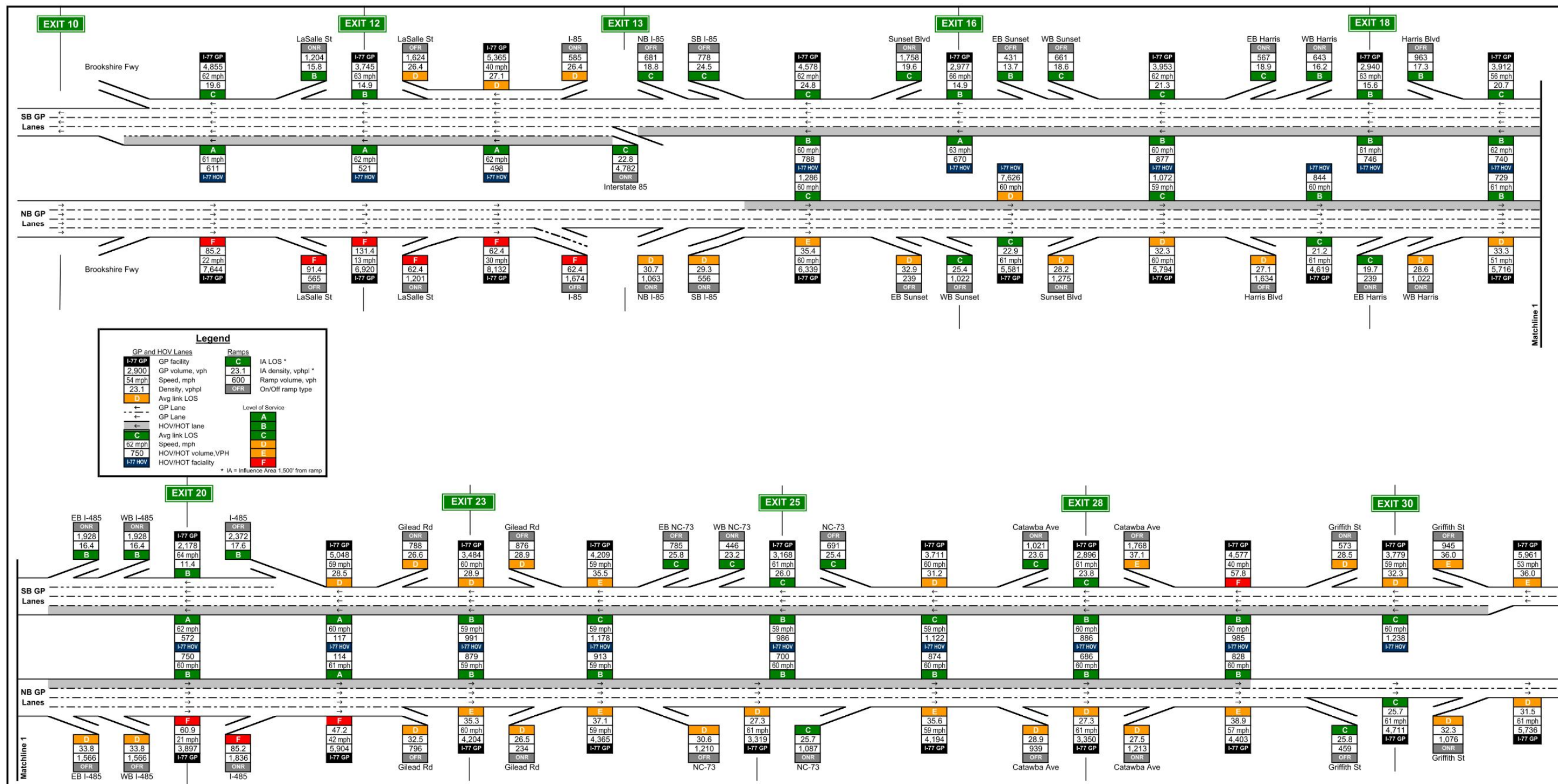
Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
AM Peak Period (7:00 a.m. to 8:00 a.m.)

Date: October 21, 2009

Created by: Dhiraj Goverdhanam

Approved by: Jonathan Reid

Figure A-11



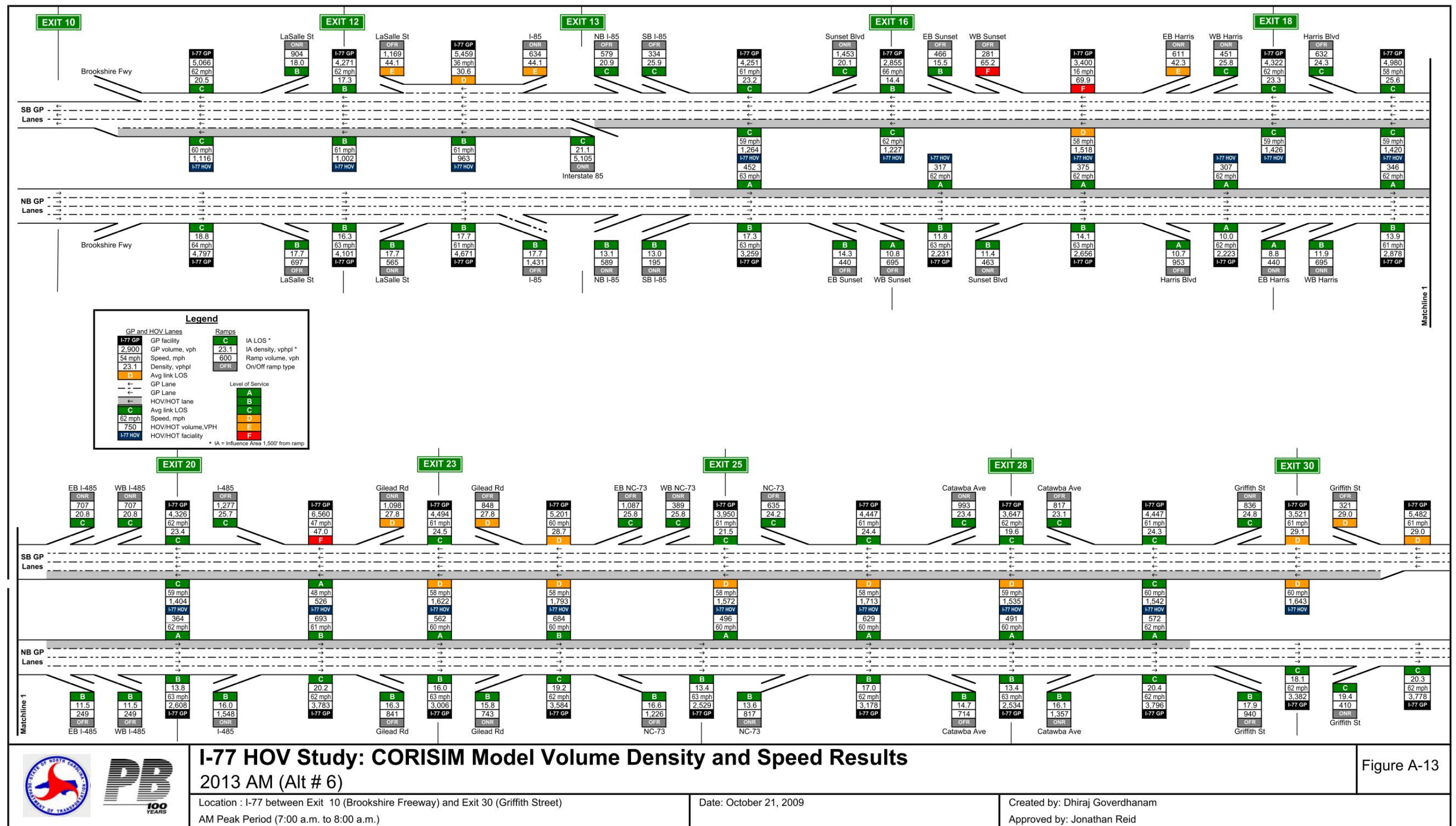
I-77 HOV Study: CORISIM Model Volume Density and Speed Results 2030 PM (Alt # 5)

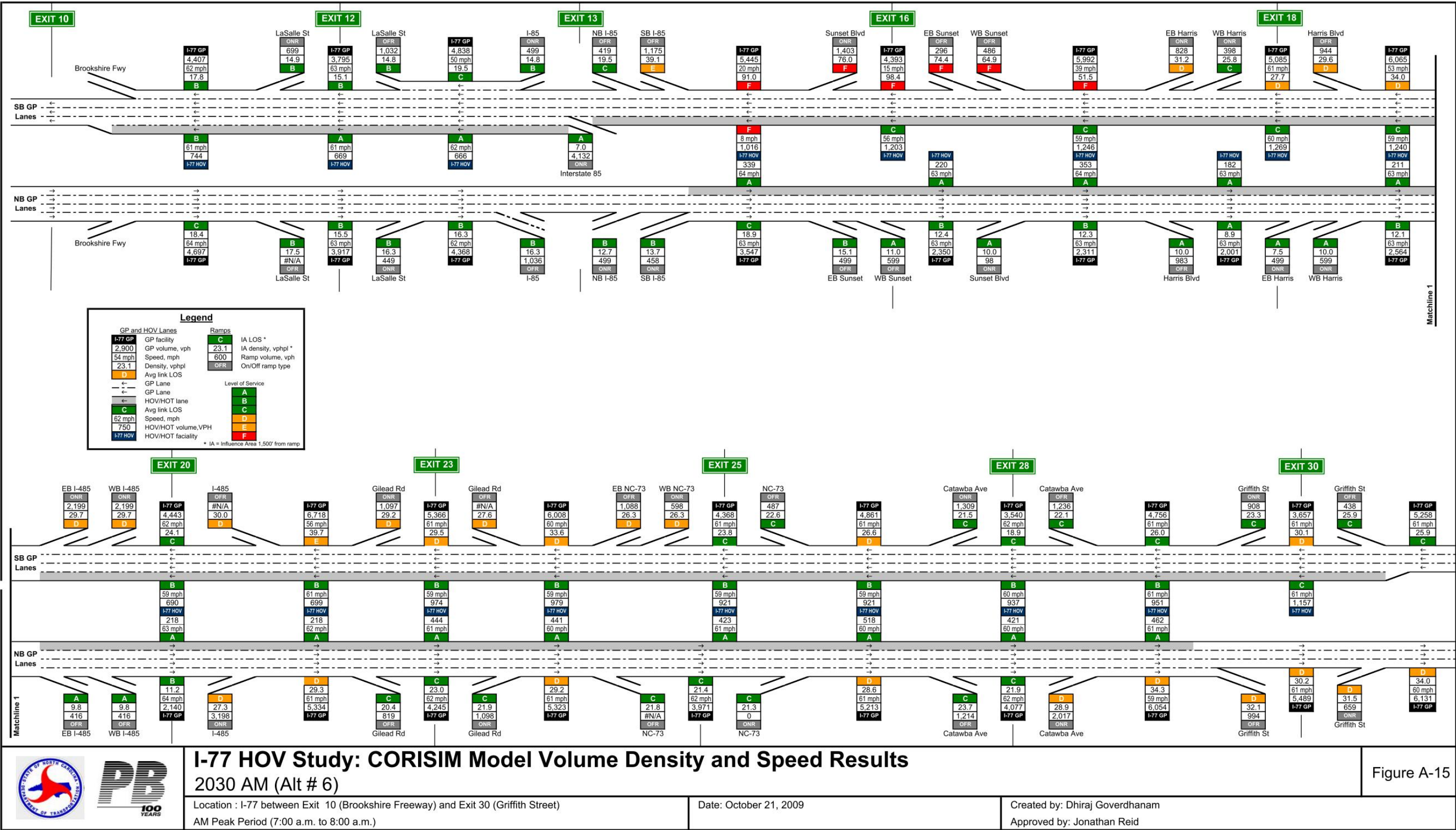
Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
PM Peak Period (5:00 p.m. to 6:00 p.m.)

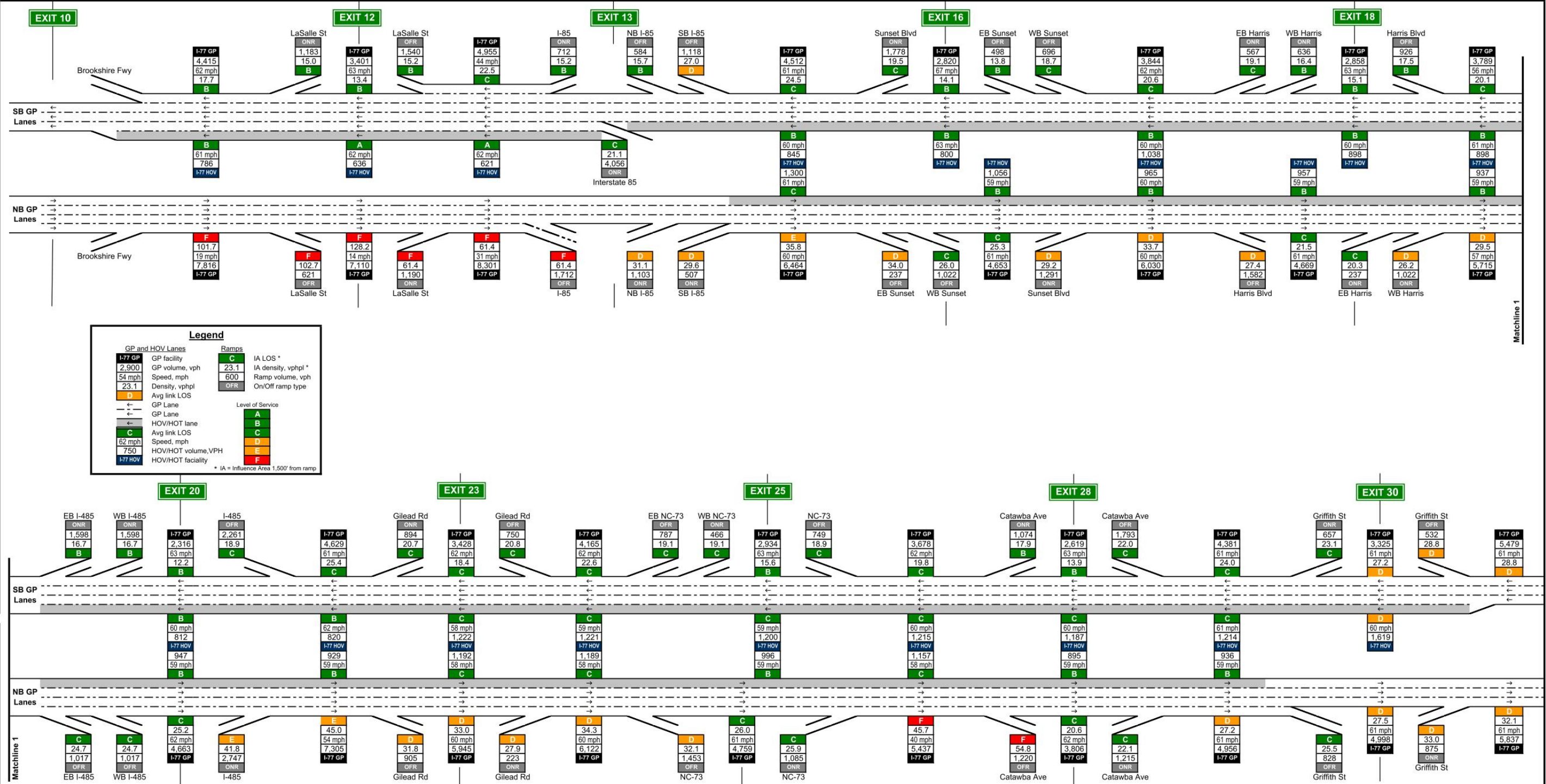
Date: October 21, 2009

Created by: Dhiraj Goverdhanam
Approved by: Jonathan Reid

Figure A-12







I-77 HOV Study: CORISIM Model Volume Density and Speed Results 2030 PM (Alt # 6)

Location : I-77 between Exit 10 (Brookshire Freeway) and Exit 30 (Griffith Street)
PM Peak Period (5:00 p.m. to 6:00 p.m.)

Date: October 21, 2009

Created by: Dhiraj Goverdhanam
Approved by: Jonathan Reid

Figure A-16